was found on Neuro 2A cells by C-dots-DA conjugate as compared to alone DA. Body weight of mice was also taken into consideration after injecting 20 μg mL^{-1} of C-dots and C-dots-DA, we did not found any change in their body weight till 45 days of observation.

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Cationic Liposomes Encapsulating Quantum Dots for Enhancing the Intracellular Delivery into Astrocytes "in vitro"

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Fluorescent semiconductor nanocrystals called ''quantum dots'' (QDs) have been synthesized for applications in many areas, such as biomedical sciences as biosensors, disease diagnostics and cell labeling, as well as in electronics and optics. In this work, cadmium telluride (CdTe) QDs functionalized with mercaptosuccinic acid (MSA) was synthesized in aqueous medium by adding a solution of Te2- ions to a solution of cadmium perchlorate and MSA, followed by reflux under argon for 10 h at 95°C. These QDs were characterized by optical spectroscopy, X-ray diffractommetry and transmission electron microscopy (TEM). Cationic liposomes composed of egg phosphatidylcholine (PC) and 1,2-dioleoyl-3-trimethylammonium-propane (DOTAP) were prepared by hydrating a lipid film at a lipid ratio of 80:20 respectively. This method consists in drying the lipids and the formation of a film under N2 for 30 min and drying it for 3 h under vacuum to remove residual solvent from the system. The hydration step was performed by adding pure water followed by stirring. The QDs have been synthesized previously encapsulated within these vesicles by the method of freezing and thawing. These vesicles were characterized by Zeta potential, Fluorescence Microscopy and TEM. Primary astrocytes from newborn Wistar rats (Pn 0 - 3, Pn = day of postnatal) were isolated and cultured in Dulbecco's Modified Eagle's Medium supplemented with F −12 (DMEM/F-12) and 10% fetal bovine serum. Upon 80% confluence, the culture medium was removed and fresh serum-free medium was added. Liposomes with and without QDs were tested in these cells with a high unspecific labeling character. The results demonstrate that liposomes present an effective entrapment of these fluorescent probes and are potential candidates for the development of diagnostics of pathologies related to glial tumor cells such as gliomas and glioblastomas.

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Probing Dynamic Reassembly of Chemically-Etched 3D Embryonic Tissue

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Most embryonic development and tissue self-assembly requires coordinated cell movements within multiple cell layers composed of different cell types and integrated signaling networks in these 3D environments. The role of cell mechanics in tissue self-assembly has been demonstrated, but little is known about the mechanical responses of 3D multi-layer tissues to chemical cues. To investigate the collective movements within multilayered tissues, we developed a novel microfluidic technique capable of ablating strips of a specified width and depth from a composite tissue. We call this technique ''3D tissue-etching'' because it is analogous to techniques used in the microelectromechanical systems (MEMS) field where complex 3D structures are built by successively removing material from a monolithic solid through subtractive manufacturing. We used our microfluidic control system to deliver a variety of tissue ablation reagents (detergents, chelators, proteases, etc.) or ''etchants'' to specific regions of multilayered tissues microsurgically isolated from embryos of Xenopus laevis. Explanted embryonic Xenopus tissues provide an ideal model for 3D tissue etching. Long exposure to a narrow etchant stream cuts completely through cell-cell layers to expose the substrate while a shorter exposure time can remove a single layer. By varying the width of the etchant and the exposure time within a single experiment a broader strip of the surface layer may be removed and then a second narrow single narrow band within the band of exposed cells in the second layer. The ability to control 3D stimulation and the shape of multicellular tissues will extend the tools of tissue engineering to synthesize highly complex 3D integrated multicellular biosystems. Integration of tissue etching in our custom microfluidic system provides a ''test-bed'' where we can implement and test a range of hypotheses concerning the control and regulation of development and cell differentiation.

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SICM-Based Nanodelivery System for Local TRPV1 Stimulation

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There is a general need to conduct single cell analysis at the nanoscale to further understand fundamental cellular processes. Within the pain research field, one interesting question that remains unanswered is whether TRPV1 channels present an organised distribution in the membrane of sensory neurons and whether it is altered during the establishment of a sensitised state. The main objective of this work was to develop a quantitative capsaicin dosing system to locally stimulate TRPV1 channels at the membrane surface of nociceptors. Local dosing was achieved by using nanopipettes as channels for the delivery, and voltage as the driving force. To achieve a quantitative delivery an accurate control of the nanopipette-cell distance is needed, for what the Scanning Ion Conductance Microscopy (SICM) positioning technology was utilised. Analytical expressions to precisely describe the distribution of molecules outside a nanopipette were obtained and compared to computational simulations. After that, the nanodosing system was successfully employed to deliver the TRPV1 agonist capsaicin to the cell body of sensory neurons. Finally, an automated multipoint delivery system was developed to assess TRPV1 response after delivery to different points at fine structures such as the dendrites.

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Developing a Framework for the Neural Stem Cell Differentiation in the Presence of Carbon Nanotubes

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Delivery of materials, such as drug compounds or imaging agents for treatment or diagnosis of disease still presents a biomedical challenge. Nanotechnological advances have presented biomedicine with a number of agents that possess the appropriate size and chemistry to pass the blood brain barrier. Functionalized carbon nanotubes are one such agent. Functionalized carbon nanotubes, shown to penetrate the blood brain barrier can potentially aid in drug and gene delivery to the central nervous system. In addition, carbon nanotubes have already been applied in several areas of nerve tissue engineering to probe and augment cell behavior, to label and track subcellular components, and to study the growth and organization of neural networks. Although the production of engineered carbon nanotubes has escalated in recent years, knowledge of cellular changes associated with exposure to these materials remains unclear. In this study, we employed multipotent C17.2 neural stem cells to probe how individual single-wall carbon nanotubes functionalized with synthetic ssDNA or RNA affect cellular processes of adhesion, proliferation, and differentiation. The research has shown that while toxicity might not be an issue at low concentration of the carbon nanotubes, irregular behavior is nonetheless observed in terms of the fate of cells after differentiation and is worth considering when developing strategies to deliver components to the central nervous system.

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Phase Change Nanoemulsions for Cancer Therapy and Imaging

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Much of the biological therapeutics currently available struggle to function as effective drug delivery vehicles due in part to their poor stability, solubility, and permeability across barriers such as the tight junctions between endothelial cells in tumor vasculature. Given this understanding, there is currently a significant interest in designing nanocarriers (< 100 nm in diameter) which are able to increase the bioavailability of drugs. In particular, much attention has been focused on nanoemulsions whose liposome-like structure protects drugs against physico-chemical and enzymatic degradation and charged surface favors drug adsorption. One novel class of nanoemulsions called perfluorocarbon (PFC) emulsions are of particular interest because they can be used both for delivering drugs and imaging tumors. In this work we show that nanoemulsions with a PFC core and Zonyl FSP surfactant shell can be produced using an oil-in-water technique via sonication. This technique is successful in producing PFC emulsions